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Determination of *in-situ* biodegradation rate constants of nonylphenolic compounds in the Seine River

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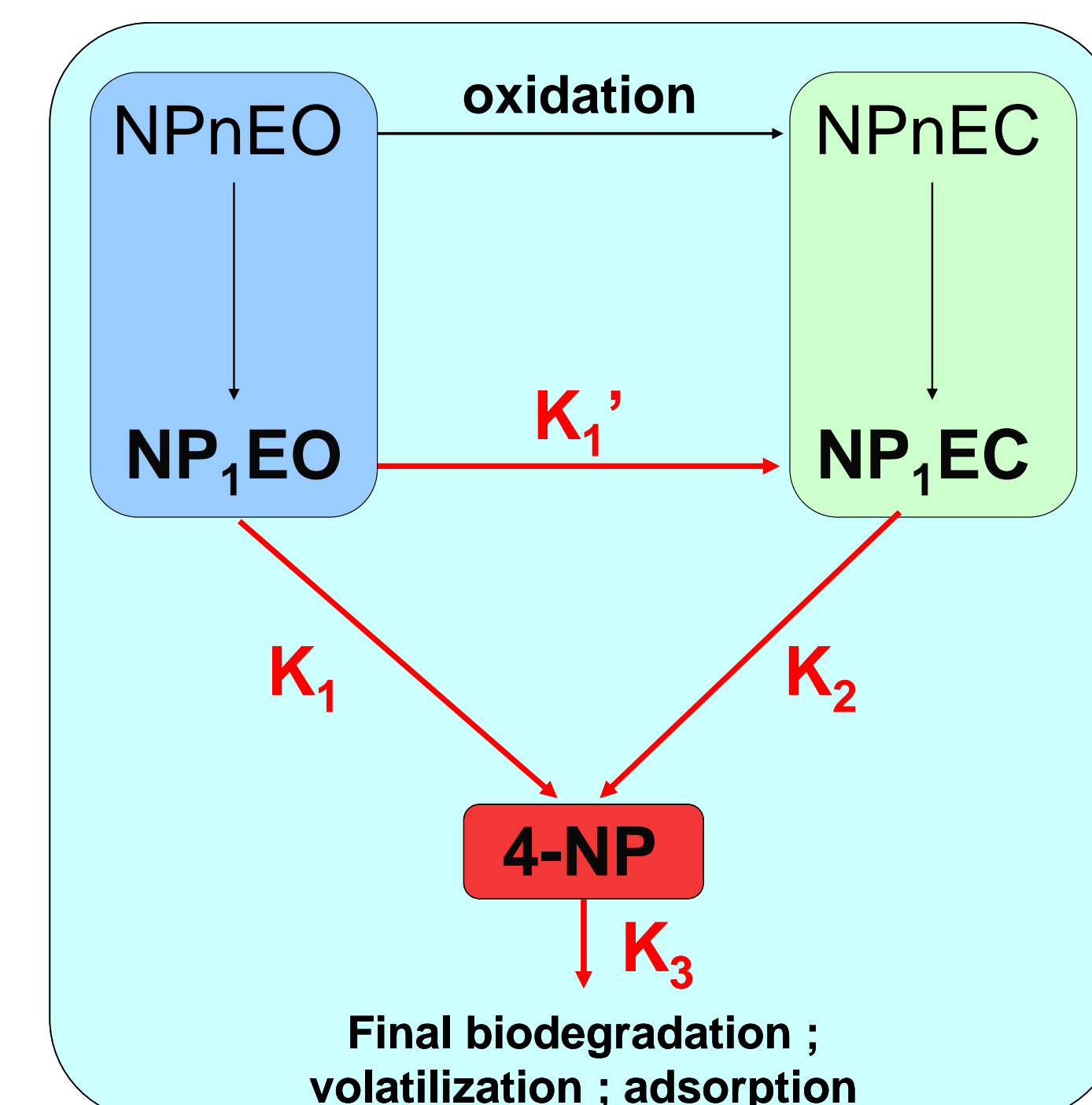
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1- INTRODUCTION

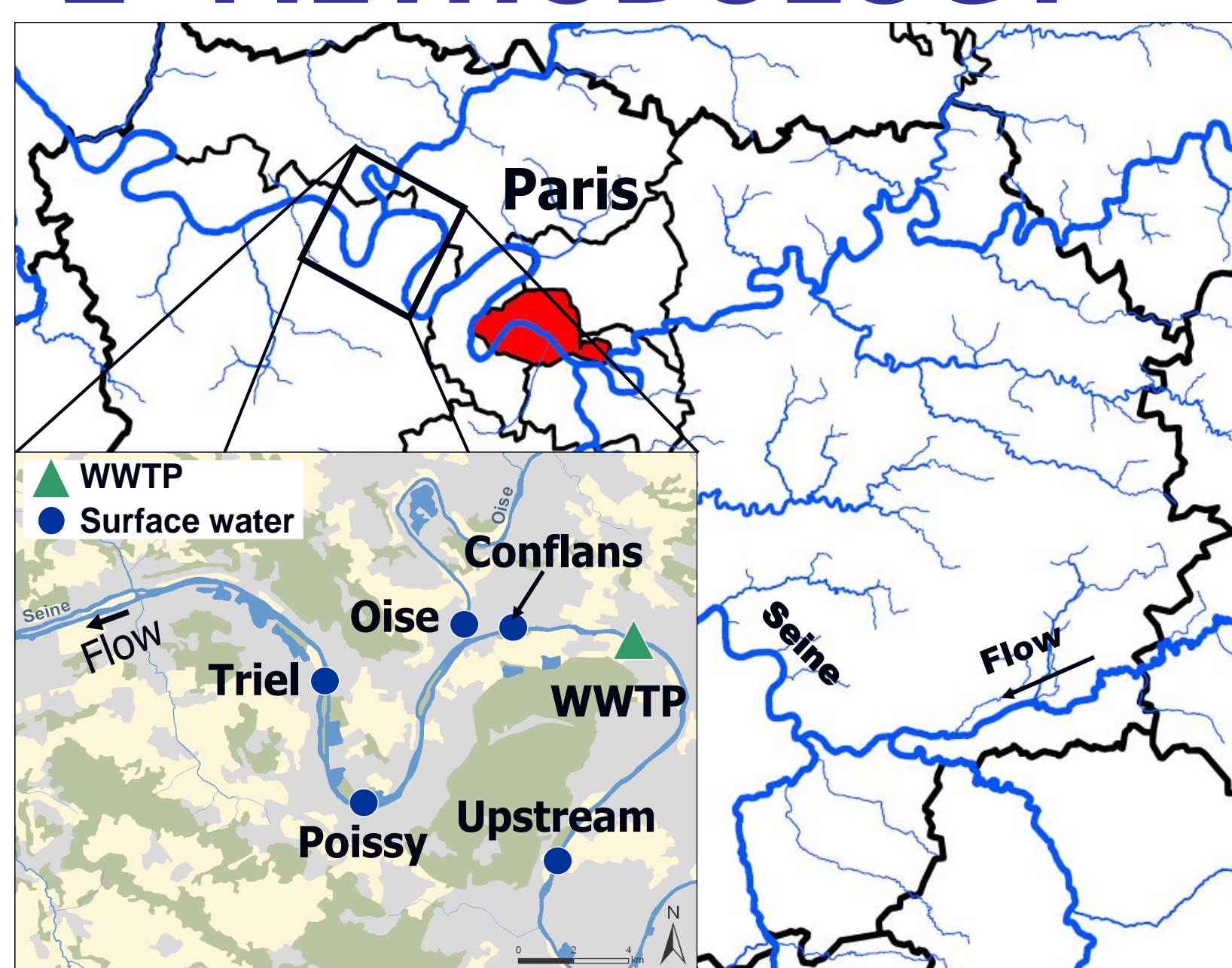
Assessing the fate of endocrine disrupting compounds (EDC) in the environment is currently a key issue for determining their impacts on aquatic ecosystems. The 4-nonylphenol (4-NP) is a well known EDC as well as its precursors, the nonylphenol monoethoxylate (NP₁EO) and the nonylphenol acetic acid (NP₁EC). they result from the biodegradation of surfactant nonylphenol ethoxylates (NPnEO). To date, the biodegradation rate constants of nonylphenolic compounds have been mostly studied in laboratory and only Jonkers et al. (2005) focus on *in-situ* rate constants but in estuarine salt water. Therefore data on *in-situ* biodegradation of nonylphenolic compounds in river water are scarce or not up to date.

This study aims at evaluating the *in-situ* biodegradation of 4-NP, NP₁EC and NP₁EO in the Seine River downstream of Paris City.



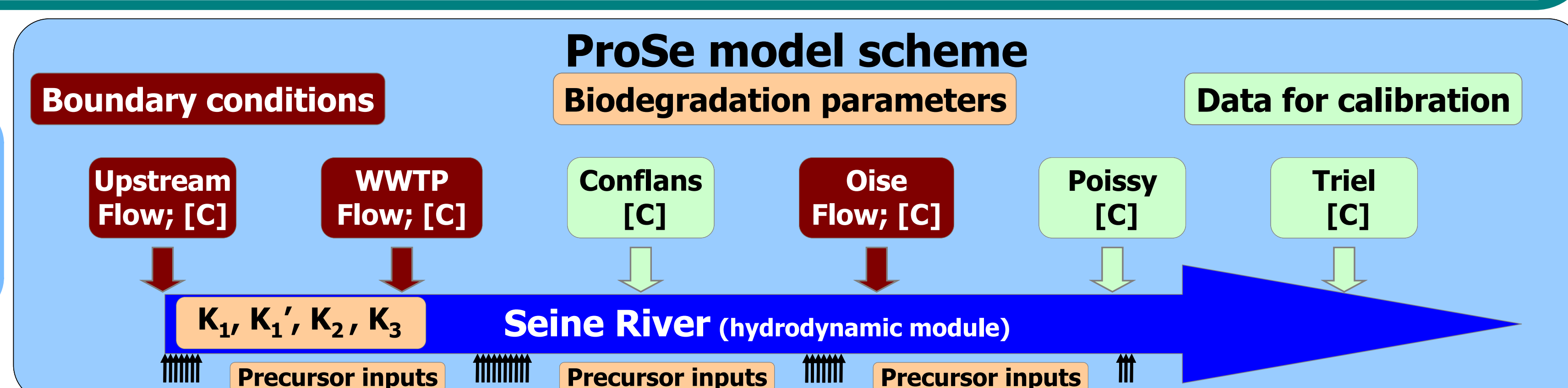
(Giger et al., 2009)

2- METHODOLOGY

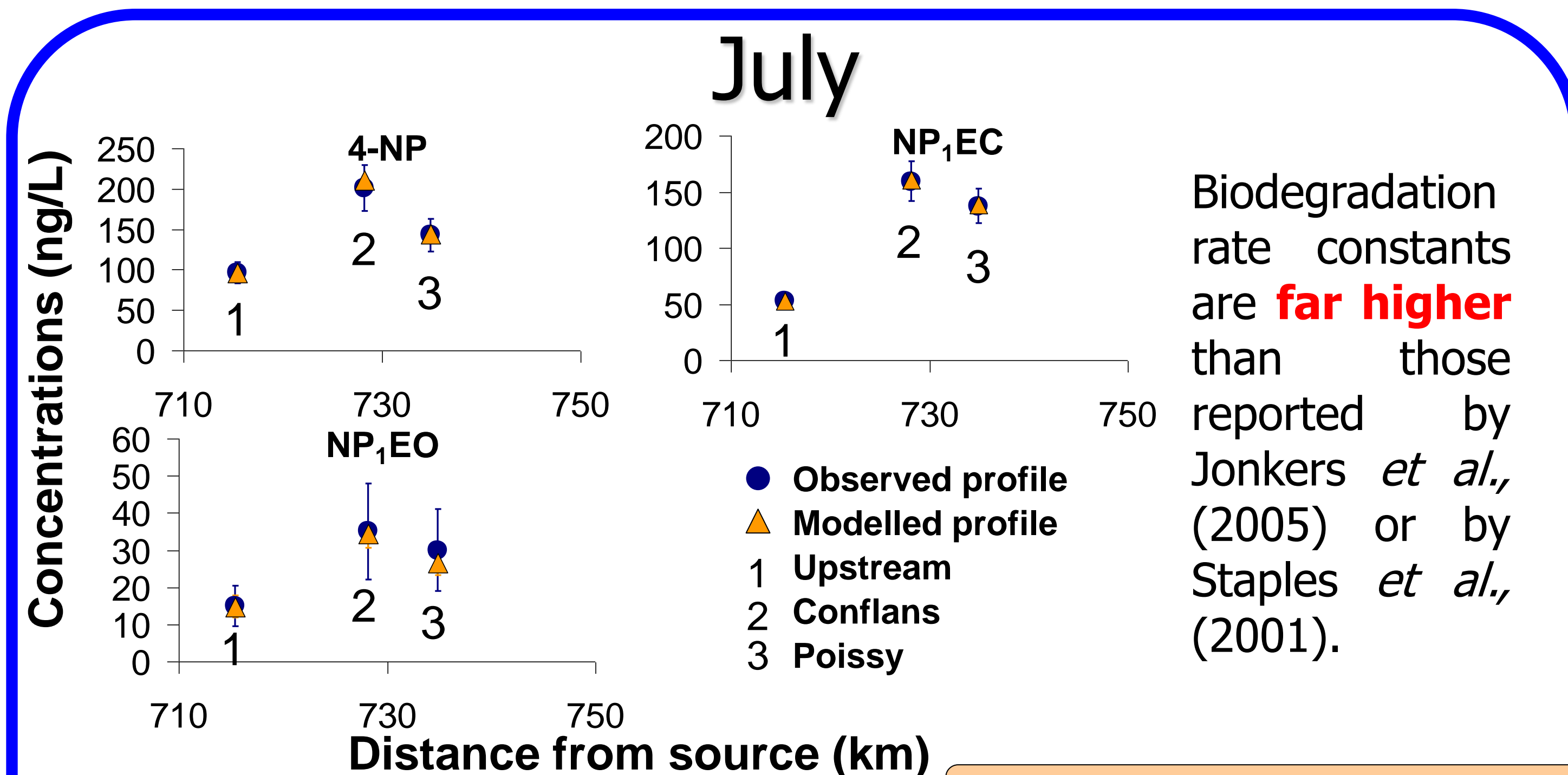


- 40 km long transect downstream of Paris city
- 2 sampling campaigns: July and September 2011
- Hours of sampling estimated according to velocity of the Seine River
- Samples collected in the same volume of water
- Analysis: UPLC-MS-MS → quantification of 4-NP, NP₁EC and NP₁EO
- Results → calibrating a sub-model of NPnEO biodegradation of ProSe model
- The spatial and temporal variabilities of concentrations are considered for calibration
- Calibration of $K_1 = K_1'$, K_2 and K_3 based on first order kinetics equations
- Calibration of "precursor inputs" to symbolize biodegradation of NPnEO and NPnEC

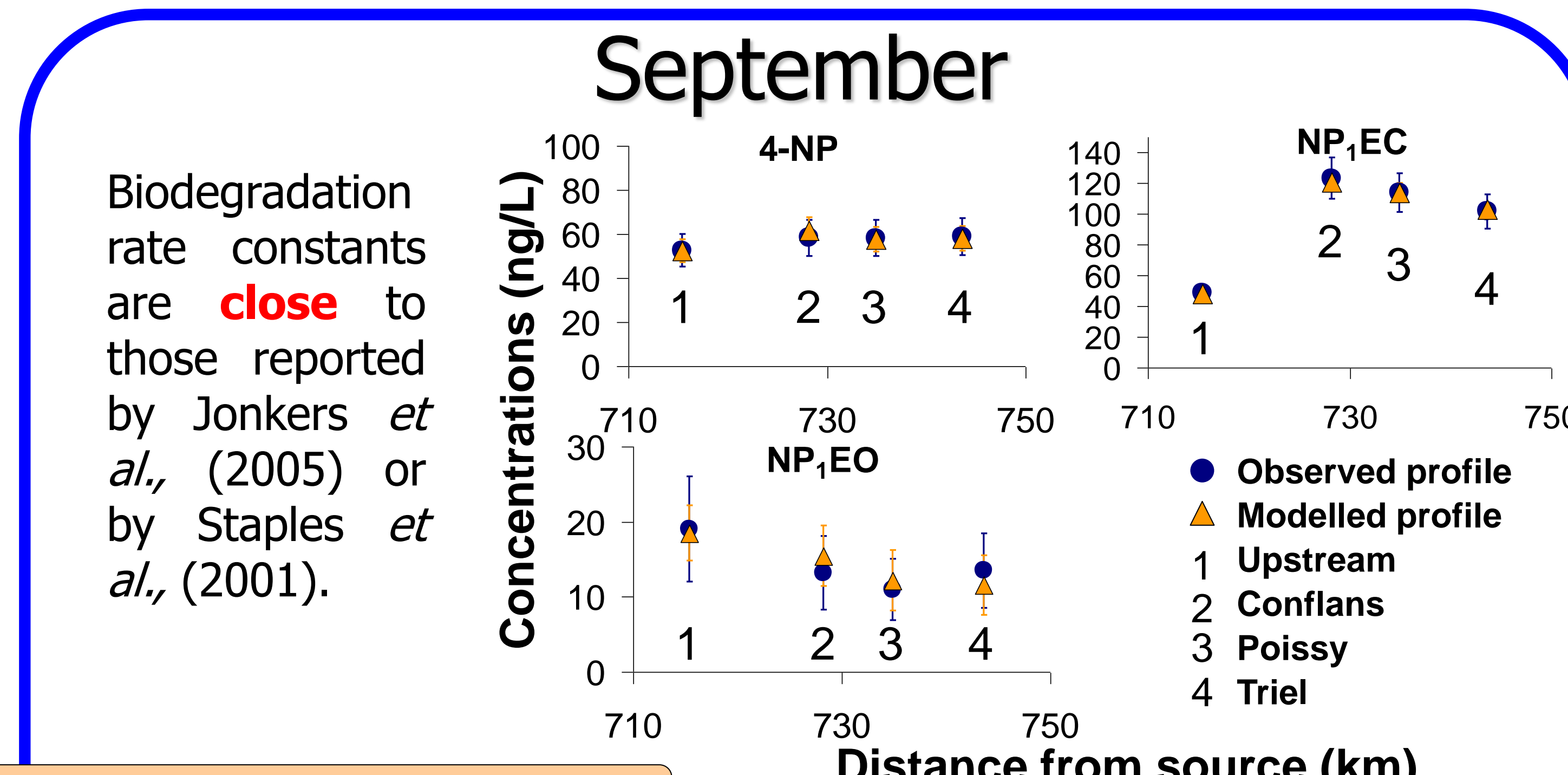
The hydro-ecological ProSe model is especially design for the Seine River. Its biogeochemical module is updated to simulate the fate of nonylphenolic compounds downstream of Paris (Even et al., 1998).



2- RESULTS



Biodegradation rate constants are **far higher** than those reported by Jonkers et al., (2005) or by Staples et al., (2001).



Biodegradation rate constants are **close** to those reported by Jonkers et al., (2005) or by Staples et al., (2001).

Significant variability of biodegradation between July and September

Campaign carried out during an **algal bloom**. This **algal bloom** likely induces an **increase of heterotrophic bacterial biomass** (Kisand and Noges, 1998)

Rate constants (d ⁻¹)	
	Min - opt - max
$K_1 = K_1'$	0.05 - 0.10 - 0.15
K_2	3.14 - 3.30 - 3.47
K_3	2.38 - 2.50 - 2.75

Min : minimum value; opt: optimized value; max: maximum value

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Rate constants (d ⁻¹)	
	Min - opt - max
$K_1 = K_1'$	0.29 - 0.30 - 0.33
K_2	0.08 - 0.10 - 0.14
K_3	0.09 - 0.15 - 0.19

Min : minimum value; opt: optimized value; max: maximum value

No disruption of biogeochemical conditions of the Seine River during this campaign. The heterotrophic **bacterial biomass** is supposed to be representative of **conventional** conditions of the Seine River

3- DISCUSSION / CONCLUSION

The **variability** of bacterial biomass likely **induces** the **variance of biodegradation** rate constants of nonylphenolic compounds.

The **first-order kinetic approach** seems **reliable** to describe a **punctual state** of biodegradation but does **not** take into account the **variabilities generated by the fluctuation of bacterial biomass**.